Diet and Nutritional Status of Ameridians: A Review of the Literature

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Este trabalho revê e avalia os dados disponíveis sobre a alimentação e estado nutricional de ameríndios que habitam as florestas pluviais tropicais da Amazônia. A alimentação da maioria dos ameríndios está baseada na mandioca e na banana, enquanto que peixes, animais silvestres e invertebrados são responsáveis por proteínas de alta qualidade. Só é conhecida a composição da alimentação ameríndia de alguns grupos. Nestes, o consumo alimentar das famílias e dos adultos parece ser adequado em termos de calorias e proteínas. Contudo, a baixa densidade calórica da alimentação, baseada na mandioca e na banana, sugere que esta não é concentrada o bastante para as crianças. Dados antropométricos de inúmeros grupos encontram-se disponíveis. Os adultos são de baixa estatura, porém o seu estado nutricional, avaliado em termos de peso/altura, é geralmente bom. As crianças são pequenas para sua idade e, em certos grupos, mais de 10% seriam classificadas como subnutridas, com base no critério peso/altura e/ou em sinais clínicos.

INTRODUCTION

Amazonia is home to a number of Amerindian groups who make a living by some combination of swidden horticulture, hunting, fishing and foraging. These populations have been disappearing at a rapid rate since the turn of the century as areas of forest and *cerrado* have been developed (Ribeiro, 1967), but there are still a number of Amerindian groups that are self-sufficient, or almost self--sufficient, in food production, and have diets that appear

to be traditional. The purpose of this paper is to review what is known of the diet and nutritional status of these groups.

Ideally we would like to be able to define Amerindian diets in terms of ecological variables, the characteristics of food resources, patterns of food selection and use, and the implications that these have for dietary adequacy, nutritional status and health. We would also like to understand how these change with contact and assimilation into Western society. However, much of what is known about diet in Amazonia is anecdotal. This kind of information is useful in providing a preliminary description of the diet, but provides little on which to judge the adequacy of the diet or potential nutritional problems. There is somewhat better information available on nutritional status, especially anthropometric indicators of nutritional status, but the interpretation of these indices is not straight forward because they are sensitive to a variety of environmental variables, as well as diet.

Amazonia is used here following Denevan (1976) to include the area of South America east of the Andes and north of the Tropic of Capricorn. It thus includes all of the tropical lowlands and interior plateaus east of the Andes. Climatically most of the area is warm and relatively humid. Rainfall is highest in the western portion around the equator. In this area rainfall is between 2500 and 3500 mm/yr with no month receiving less than 100 mm. There is no real "dry" season, but there is typically a period of 2-3 months of relatively low rainfall. Moving east rainfall decreases to 1000 - 2000 mm/yr and becomes more seasonal. In Central Brazil there is a dry season of 3-4 months (Prance, 1978).

For descriptive purposes it is useful to divide Amazonia into three regions: northern, western and southern peripheral Amazonia. These distinctions conform to Fittkau's ecological subregions (Herrera et al., 1978). A fourth region, central Amazonia, which includes the floodplain of the Amazon River itself, is not considered here since its inhabitants were not known ethnographically.

The Amerindian groups for which there is some information on diet are described below. At the time they were observed almost all had subsistence systems based on

swidden horticulture, hunting, fishing and gathering, and except for the *Xavánte*, inhabited tropical forest environments. The dates during which they were observed are only a rough guide to their degree of acculturation, since contact and assimilation have proceeded at very different paces in different parts of Amazonia.

General characteristics of Amazonian diets

In northern peripheral Amazonia the groups inhabiting low lying forested regions along rivers shared a diet based on bitter cassava (*Manihot esculenta*) prepared as bread (*casabe* or *beiju*), or meal (*fariña* or *mañoco*), and fish.

Boza and Baumgartner (1962) studied *Piapocos*, *Piaroas*, and *Guahibos* living along the upper Orinoco and Venturari Rivers in Venezuela in 1952. *casabe* was the most frequently consumed food, followed in rank order by fish, *yucuta* (*fariña* and water), meat, fruits (all types), and maize. Of the fruits consumed, palm fruits were the most important in the diet. In addition to game animals, they also reported the use of a variety of small fauna including frogs, snakes, bats and insects.

The *Tiriyó* and *Wayána* in the Guianas were studied by Glanville and Geerdink (1970) in the mid 1960's shortly after their first contact with missionaries. They appeared to have a very similar diet to that of the *Piapocos*, *Piaroas* and *Guahibos*. More recent work by Dufour (1983) with *Tatuyo-Tukananos* in the Vaupes region of Colombia in the late 1970's, and by Holmes (1981) with the *Kuripáko* in the San Carlos de Rio Negro region of Venezuela in the early 1980's, also indicates similar diets based on *casabe* and fish.

The *Yanomámi* who inhabit interior mountainous rain forest regions along the Venezuelan-Brazilian border away from the major rivers, have a somewhat different diet. According to ethnographers, plantain/banana were the dietary staples, and game the principal source of animal protein (Lizot, 1977; Smole, 1976). Until very recently they were one of the groups with the least contact with westerners.

In western peripheral Amazonia there are a number of groups inhabiting the rain forests on the lower slopes of

the Andes (*montaña*) and in the adjacent lowlands. Information on diet is available for the *Aguaruna* (Berlin and Markell, 1977) and *Siona-Secoya* (Vickers, 1989) for the mid 1970's, and from the *Shipibo* from the early 1980's (Behrens, 1984; Hodges and Dufour, 1991). These groups share a broadly similar diet based on sweet cassava, plantains and bananas, and fish and game. In this region much of the cassava is consumed as a premasticated, slightly fermented drink (Behrens, 1984; Berlin and Markell, 1977; Dricot-D'Ans and Dricot, 1978; Ross, 1976; Vickers, 1989).

For Amerindians in southern peripheral Amazonia there is no detailed information on diet, but there appears to be more diversity in the foods used. Coimbra (1985) described the *Suruí* of the Aripuanã Park in 1979-83 as relying on maize as a dietary staple and game as the principal source of animal protein. For the *Menkrangnotí-Kayapó* (Central Brazil, state of *Pará*) described by Werner (1983) in 1976-77 food staples were: sweet potatoes, bitter cassava, plantain and maize in that order. Meat, from a variety of game animals, was the principal source of animal protein. Although the *Menkrangnotí* trekked several months of year, they did not consume much wild vegetable food, with the exception of Brazil nuts (*Bertholetia excelsia*). For Amerindians in the *Alto Xingu* area the staple foods were reported to be bitter cassava, prepared as *beiju* and fish. These groups reportedly used a variety of "wild" fruits and nuts, as well as honey (Eveleth et al., 1974; Fagundes-Neto et al., 1981). Their diet appears to be similar to that of the riverine-oriented groups in northern peripheral Amazonia.

The *Xavánte* live further south and east in an area of *cerrado* vegetation on the Central Brazilian Plateau. Maybury-Lewis reported that in 1955-58 they were living in the *cerrado* and swiddening in gallery forest. They trekked all year except for about the three months they devoted to horticulture. Their diet was based on wild roots, *palmito*, wild nuts, fruits and game (Maybury-Lewis, 1967: 43-44). The roots functioned as the carbohydrate staple, but whether they were actually "wild" rather than cultivated is open to question. In the swiddens the *Xavánte* grew maize, beans and pumpkins, and these foods were

important in the diet right after the harvest. This description agrees with that of Freitas and Oliveira (1955) for the *Nação Xavánte* in 1954.

The more recent work of Flowers (1983) with the *Xavánte* at Pimental Barbosa in 1976-77 indicates that they have adopted upland rice as a dietary staple, and were trekking only about two weeks of the year. They collected "wild" roots only occasionally, but did collect large quantities of *palmito*, palm nuts and other fruits. *Palmito* was eaten fresh, or dried and pounded into a flour which was boiled into a thick soup. Game was more important in the diet than fish. Flowers (1983) reported that they sold some of their rice, but included few purchased foods in the diet.

Composition of Diets

More detailed information on diet composition is available for five groups: *Aguaruna*, *Shipibo*, *Siona-Secoya*, *Tukánoans* and *Yanomámi*. Energy and protein intake in these diets is summarized in Figure I. All of the data is at household or village level and restricted to one season of the year. In four of these diets between 76 and 87% of the energy is derived from two staples, cassava and plantains/bananas. After the starchy staple, fish and game are the second most important source of food energy.

Although a wide variety of crops were cultivated by each of these groups, other cultigens were relatively minor components of the diet, providing between 0 and 9% of all food energy. The *Siona-Secoya* diet described by Vickers (1989) shows a slightly different pattern: cassava and plantain provide 53% of the food energy and other cultigens provide 19%. Almost all of the latter was derived from peach palm fruit (*Bactris gasipaes*), which is only available seasonally. The composition of the *Siona-Secoya* diet reported by Bénéfice et al. (1989) is more similar to that of other groups with about 72% of the food energy coming from the staples, cassava and plantains/bananas.

Uncultivated plant foods contributed between 0 and 7% of all food energy. The *Yanomámi*, the least acculturated group, relied more heavily on these foods than did the other four groups. Palm fruits were the most important

wild vegetable foods. Boza and Baumgartner (1962) present food frequency data for the *Piaroas*, *Guahibos* and *Piapocos* which also suggests greater reliance on uncultivated plant foods than was found in the *Aguaruna*, *Shipibo*, *Siona-Secoya* and *Tukánoans*.

More than half of all the protein in these diets is coming from fish and game (Figure I), so the protein quality of the diets is high. With the exception of *Yanomámi*, fish were the most important source of animal protein, and that seems to be true for a number of other groups as well. A wide variety of game animals are consumed, but small mammals, such as rodents are usually the most important. These are of course the more abundant in the ecosystem. The category "other" includes insects and small vertebrates, like frogs. These sources of animal protein are frequently mentioned by observers, and probably more important than most of the available data indicate (Dufour, 1987).

FIGURE I-A

Energy and Protein Composition of Five Amerindian Diets

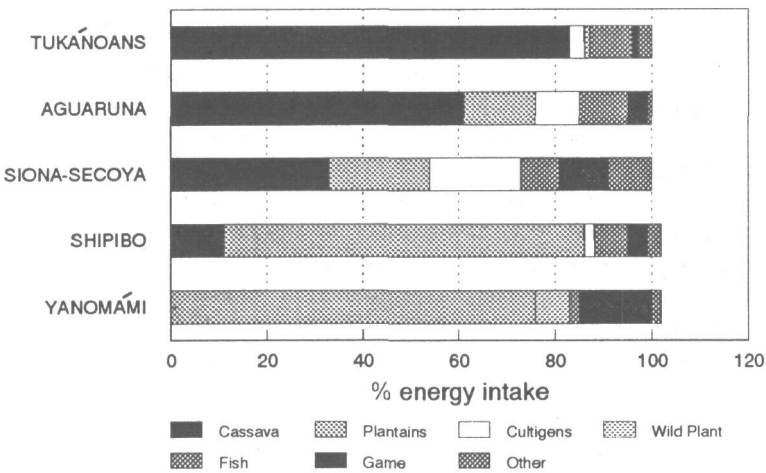
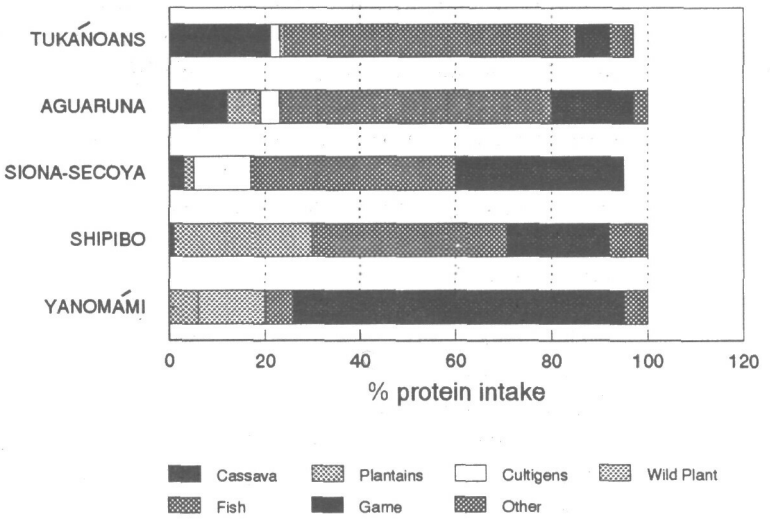


FIGURE I-B



Aguaruna data from Berlin and Berlin (1977) based on 30-day weighed records for 5 households. Records were kept by the subjects. "Cultigens" were primarily fruit; "other" is a mixed category which included roots and tubers, seeds and other plant parts, as well as crustaceans, frogs and insects. Approximately a third of the energy derived from cassava was in the form of cassava beer or *masato*. *Shipibo* dietary data calculated from Behrens (1986) from weighed intake records for 17 households visited on 25 different days. "Cultigens" included rice, potatoes, squash and beans; "other" included domesticated pork and chicken. Values do not include fruits or wild plant food, which Behrens estimated to be less than 1% of the total weight of all foods consumed. *Siona-Secoya* data from Vickers (1989) for 3-day weighed records for four adults and one child. Cultigens included peach palm (16% of total food energy), papaya and sugar cane; "other" included rice and sugar. *Tukánoan* data from Dufour (1983) from 3-day weighed records for four households. "Other" is primarily insects. *Yanomámi* data from Lizot (1977) based on 42 days of "observation" in one village and 28 days in another. Method used unclear. "Other" includes insects and crustaceans.

In terms of macronutrients Amerindian diets appear to be high in carbohydrates and quite low in fat. In the *Tukánoan* diet approximately 81% of the food energy is derived from carbohydrate, 11% from protein (8% from animal protein), and 8% from fat (Dufour, 1984b). The *Siona-Secoya* diet is similar, 75% carbohydrate, 14% protein and 11% fat (Vickers, 1989:149). The level of energy derived from protein in these diets is not unusual in self-selected diets (FAO/WHO, 1973:22), but the percent of energy derived from fat is very low.

Cassava as a staple

The distinction between bitter and sweet cassava made ethnographically is usually in terms of informant/observer preceptions of how toxic the roots are, and/or how they are prepared. "Sweet" cultivars have roots which can be eaten simply roasted in the coals, or peeled and boiled. Roots of "bitter" cultivars, on the other hand, require more elaborate processing to remove their bitter taste and make them safe to eat. Roots of these varieties are typically prepared as *casabe*, or *fariña*. Sweet cassava can also be prepared *casabe* or *fariña*, so that the presence of these two products in the diet does not necessarily mean that the roots being used are bitter varieties. Botanically the distinction between bitter and sweet cassava is usually in terms of cyanide content; roots with a cyanide content of 100 ppm or more are considered high-cyanide or "bitter".

The cyanide content of cassava is a potential health hazard, and indeed some researchers consider the bitter cultivars unsuitable as human food (Gomez et al., 1984). Cyanide toxicity associated with cassava consumption has been linked to a number of health problems in Africa, including acute toxicity, goiter and spastic paraparesis (Nestel and MacIntyre, 1973; Ermans et al., 1980; Osuntokun, 1981; Rosling, 1987). Cassava consumption has not, however, been associated with health problems in Amazonia, even though some groups rely on cassava for a large percentage of their dietary energy, and use unusually bitter varieties (Dufour, 1988). This probably reflects the adequacy of traditional food processing

systems in reducing cyanide to physiologically tolerable levels (Dufour, 1989), as well as the general adequacy of their diet in providing substrates for metabolic detoxication of residual cyanide. None the less, the health significance of the residual cyanide in Amerindian diets remains to be clarified.

Seasonal variations in diet and wild food use

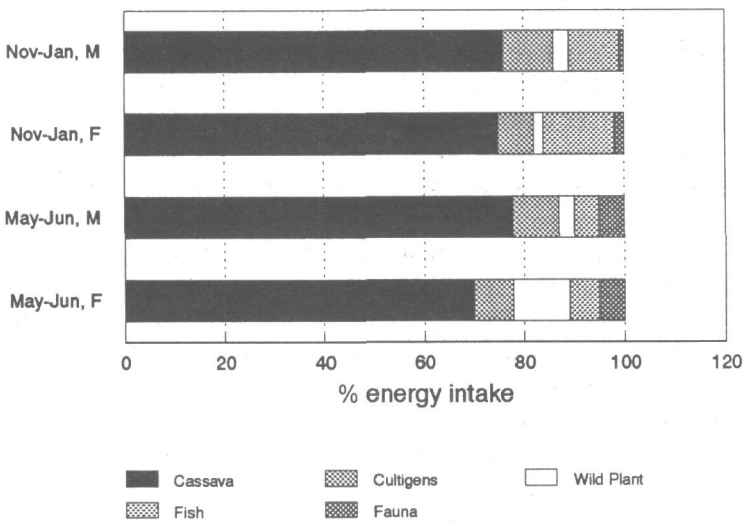
Seasonal variations in diet have not been well studied. Seasonal variations in total food supply are probably less important in rain forest regions than in the drier tropics because the dietary staples, cassava and plantain, are under continuous cultivation, and harvested throughout the year. However, the intake of wild vegetable and animal foods would be expected to vary during the year in accordance with their availability. The consumption of some cultigens would also be expected to vary seasonally. The high intake of peach palm fruit (*Bactris gasipaes*) in the *Siona-Secoya* diet is a good example of this.

In the *Tukánoan* diet, cassava and other cultigens did not show much seasonal variation (Figure II), but animal foods and uncultivated plant foods did. Fish was more important in the diet in the November-January period, the dry season, the time of the year when fishing is most productive. Uncultivated plant foods were more important in the rainy season, a time of the year when many trees come into fruit. Some insects are especially abundant during this time of the year as well.

Most of the wild plant foods collected were nuts and seeds of large trees, and palm fruits. These are generally good sources of fats and protein. In one year, 1977, impressive amounts of two seeds, *Erisma Japura* and *Monopteryx angustifolia*, were collected (Dufour and Zarucchi, 1979). It is worth noting however, that both of these were from trees that only fruit on alternate years, and the next year neither were available. Both of these seeds were considered toxic and detoxified for consumption. The presence of toxins in the wild plant food component of the diet is an area of research that deserves more attention.

FIGURE II

Seasonal Variation in the Diet of *Tukánoan* Adult Males and Females. See Table 3 for Sample Sizes



The relatively limited contribution of wild plant foods to Amerindian diets may be simply an artifact of the methods used to collect the dietary data, or the season of the year the data were collected, or the age of the settlement, or some combination of these three factors. First, methods that do not account for foods eaten away from the settlement tend to under report both wild plant foods and small fauna. Second, for the horticultural groups discussed here, the most important wild plant foods appear to be tree fruits, which are highly seasonal in availability, rather than starch storage organs such as palm heart, which should be available all year long. Since almost all of the data

the year, it is likely that wild plant use was underreported. Third, some groups rely more heavily on wild plant foods at new settlements when their gardens are young and not in full production (Hill and Kaplan, 1990; Vickers, personal communication).

Age and sex differences in diet and food intake

There is little quantitative data on age and sex differences in diet among Amerindians, but ethnographic information suggests they may be important. There are a number of reports of food restriction during illness and life cycle events such as child birth. Further, in some groups, such as *Tukánoans* and *Mehináku* (Central Brazil), there are prolonged initiation rites during adolescence which are associated with severely restricted diets (Hugh-Jones, 1979; Gregor, 1985). In the case of the *Mehináku* the appearance of neurological disorders in young male initiates has been associated with the ingestion of certain wild plants during the period of seclusion (Gregor, 1985:148).

In the *Tukánoan* data sex differences in the diets of adults are not very great. The most striking is the greater use of wild vegetable foods by females in the May-June period. This suggests that exposure to toxins and other secondary compounds in the wild plant component of the diet may vary between the sexes.

The diets of children have not been investigated, but they may differ in important ways from those of adults.

ADEQUACY OF AMERINDIAN DIETS

The adequacy of indigenous diets is difficult to judge. Basically there are three types of criteria which can be used to evaluate the adequacy of a diet. First, energy and nutrient intake of a group of individuals in relationship to a standard. The most useful measurements are those of individuals of known sex, age, body weight and activity level carried out over a number of days during the annual cycle. Second, a measure of the adequacy of energy intake in relationship to energy expenditure. Third, indicators of biological status, such as anthropometric indices and clinical signs.

Food intake in relationship to a standard

In terms of the first of these measures, food intake in relationship to a standard, there is very little data available. Household level food intake data for *Aguaruna* (Berlin and Markell, 1977), *Siona-Secoya* (Bénéfice et al., 1989), and *Tukánoans* (Dufour, 1983) suggest that intakes of energy and protein were adequate, but this is quite a crude measurement.

Results of a weighed food intake survey of *Tukánoan* adults in 1977-78 are shown in Table I. Mean energy intakes were 100% or more of the FAO/WHO (1973) recommendations for moderately active adults of corresponding body weight. For *Tukánoans*, energy intakes also appeared adequate in comparison to estimates of energy expenditure (Dufour, 1984a). Mean protein intakes were above the FAO/WHO (1973) safe level for both men and women. There was, however, considerable day to day variation in intake, due to the fluctuations in availability of wild fauna. Seasonal differences in protein intake were also greater than in total energy intake.

TABLE I

Mean (SD) Daily Energy and Protein Intakes, Percent FAO/WHO (1973) Recommendations, and Mean Daily Energy Expenditure of *Tukánoan* Adults by Sex and Season

	ENERGY		PROTEIN		EE
	Kcal	% FAO	g	% FAO	Kcal
Males					
Nov-Jan (n=27)	3335±630	113	96±74	218	2806±382
May-June (n=10)	3017±844	100	70±32	152	2956±605
Females					
Nov-Jan (n=30)	2413±592	106	80±65	200	2133±272
May-June (n=13)	2396±757	123	65±37	176	2051±248

* N is the number of person-days. Weighed diet records were kept for 3 consecutive days for 9 males and 10 females in November-January (1977-1978), the dry season, and 1 day for 10 males and 13 females in May-June (1978), rainy season. Adequacy of protein intakes is based on the assumption that the diet has a protein quality of at least 70% relative to milk or eggs.

Protein intakes estimated from creatine excretion were adequate for *Tiriyó* and *Wayána* adults and children (Glanville and Geerdink, 1970). This is the only data on dietary intake available for children.

There is no minimal s andard for fat intake, but it is generally assumed that diets in which fat contributes <15% of calories are not concentrated enough for young children (Wheeler, 1980). If the percentages of fat in the *Tukánoan* and *Siona-Secoya* diets (8 and 11% respectively) are representative, Amerindian diets have very low energy density, and the sheer volume of food required to meet energy needs is a potential constraint for children. The problem of food volume is most acute in western peripheral Amazonia because a high proportion of the food energy is in the form of cassava beer or banana gruels. The high bulk of the *Aguaruna* diet was pointed out by Berlin and Markell (1977).

The adequacy of other nutrients in Amerindian diets has been reported for *Aguaruna* and *Siona-Secoya* households. *Aguaruna* diets were adequate in calcium, phosphorus, iron, vitamins A and C, thiamin, riboflavin and niacin (Berlin and Markell, 1977). *Siona-Secoya* diets were adequate in all of those same nutrients except vitamins A and riboflavin (Bénéfice et al., 1989).

Anthropometric indicators of nutritional status

Anthropometric indices of nutritional status for the groups considered here are summarized in Table II. In terms of weight-for-height, a measure of thinness and hence present nutritional status (Waterlow et al., 1977), most children and adults are within the normal range. The highest percentage of thinness is among the *Aguaruna* and *Shipibo*, groups in the montaña region. There is less data available for height-for-age, an indicator of linear growth over time (Waterlow, 1977). However, children in the two of the three groups for which there is data, *Curripacos* and *Tukananos*, show high frequencies of stunting. In *Shipibo* infants and young children deficits in linear growth in comparison to reference values begin between 3 and 6 months of age and continue through 36 months (Hodge and Dufour, 1991). Given the short stature of the adults in

all of these groups, stunting in childhood is probably common. Stunting is considered indicative of long term nutritional inadequacy, and/or generally poor environmental conditions, especially those in which chronic or repeated infections are prevalent (WHO, 1986). Hence it is a nonspecific indicator of the general quality of life.

TABLE II

Anthropometric Indices of Nutritional Status for Selected Amerindians, Sexes Combined. Percent of Individuals Less than 80% Standard* Weight-for-Height (WT/HT) and/or Less than 90% Standard Height-for-Age (HT/AGE)

Group (Date)**	Age, yrs	n	WT/HT	HT/AGE
PRE-SCHOOL CHILDREN				
Aguaruna (1972-75)	1-5	35	35	—
Kuripáko (1980-83)	0-5.9	34	0@	32
Kayapó (1970-76)	0-5.9	87	—	16
Shipibo	<10	43	14	—
Tukánoans (1976-87)	2-5.9	120	0@	56
Yanomámi (1982)	?	93	1@	—
Xingu Tribes (1974-76)	0-5	175	<1	—
SCHOOL CHILDREN				
Aguaruna (1972-75)	6-19	32	12	—
Kuripáko (1980-83)	6-17	52	0@	—
Tukánoans (1976-87)	6-19	481	<1	—
Yanomámi (1982)	?	102	2@	—
ADULTS				
Aguaruna (1972-75)	20+	50	10	NA
Kuripáko (1980-83)	18+	47	0@	NA
Tukánoans (1976-87)	20+ M	205	0@	NA

* Harvard standards as quoted by Jelliffe (1966). Age grouped as recommended by Waterlow et al. (1977) when possible; no age data available for *Yanomámi*. Height for age is not applicable for adults (NA). Absence of data indicated by dash (-).

** References are as follows: *Aguaruna* (Berlin and Markell, 1977); *Kuripáko* includes Amerindians in San Carlos de Rio Negro and surrounding villages (Holmes, 1981); *Kayapó* includes *Xikrín* and *Menkrangnotí*, data read from growth charts in Black et al. (1977); *Shipibo* (Behrens, 1984); *Tukánoan* data include *Kubéu*, *Tukáno*, *Tatuyo*, *Karapanã*, *Barasána*, *Desána* groups living in the Vaupes region of Colombia on Cuduyari, Quereri, Alto Papuri, Paca Rivers (Dufour, n.d.); *Yanomámi* data read from figure in Holmes (1985: 250); *Xingu* tribes include *Kamayurás*, *Awetís*, *Waurá*, *Yawallapitís*, *Mehinakús*, *Kuikúru*, *Kalapálo*, *Matipú-Nafukwá*, *Trumáis* (Fagundes-Neto et al., 1981).

The lack of dietary intake data for children makes it difficult to estimate the extent to which nutritional variables are responsible for slow growth. The possibility of chronic or recurrent food deficits in children's diets resulting from fluctuations in household food supplies, and/or inequitable food distribution within the household cannot be ruled out. Further, the high bulk, low caloric density of Amazonian diets may make it difficult for young children to meet their dietary needs when food is available, or to catch up after a period of deficit.

There is also ample evidence of chronic and repeated infections among Amerindian children. Holmes (1984) demonstrated the negative impact of measles on nutritional status in the San Carlos area. Malaria was endemic among the *Alto Xingu* groups (Fagundes-Neto et al., 1981), *Kayapó* (Ayres and Salzano, 1972), *Tiriyó* and *Wayána* (Glanville and Geerdink, 1970), and malarial infections have been associated with faltering growth (McGregor, 1982). Intestinal parasitism is common (Larrick et al., 1979; Berlin and Markell, 1977; Holmes, 1984; Bénéfice et al., 1989), but its impact on nutritional status in not entirely clear. Holmes (1984) found no relationship between weight-for-height and worm burden in San Carlos children, but other studies have shown that deworming enhances linear growth (Evans et al., 1985). There are also a number of reports of mild, but probably chronic, infections which could depress growth in children. Examples of these are eye disease among the *Tiriyó* and *Wayána* (Glanville and Geerdink, 1970), and skin diseases among the *Kayapó* (Ayres and Salzano, 1972) and the groups studied by Boza and Baumgartner (1962), and oral infections among *Tukánoans* and San Carlos childern (Holmes, 1981).

Climatic conditions themselves, via their effect on thermoregulation, are an additional factor which may also contribute to the short stature seen. The shortest human groups in both South America and Africa are found in areas of tropical rain forest (Hiernaux and Froment, 1976; Stinson, 1990).

TABLE III

Summary of Positive Clinical Signs Reported in Amerindians by Group and Date of Observations

	Positive clinical signs*, percent														
	Hair			Face	Eyes		Lips	Tongue	Gums	Glands	Skin				
Group (date)**	LL	Thn	Dysp	MF	PC	CX	AS	Red	Spng	Thyr	PD	FH	X	Edema	Hepatomegaly
Aguaruna (1972-75)															
Young child (n=35)		26	52		23		6		9					6	
Schoolchild (n=32)	6	25	38		45				52						
Adults (n=50)	2	4	2		26				60	4					
Kayapó (1966)															
Children					<1	3									28
Adults					2										15
(total n=184)															
Piaroas, Piapocos, Guahibos															
Young children (n=64)													3		
Schoolchildren (n=223)								<1	<1		1	1	<1		
Adults (n=265)							6	6	23		5	2	17	3	
San Carlos (1980)															
Young Children (n=16)		25	50	12					6						
Schoolchildren (n=37)		11	11											5	
Adults (n=41)			5											7	
Tukánoans (1981)															
Children (n=61)	61	52	57		63										
Waorani (1976)															
Children															
Adults										2					
(total n=293)															
Witotos (1968)															
Young children (n=119)					1										
School children (n=109)					1										
Adults (n=397)					4										

Includes signs listed in Group I by Jelliffe (1966): for the hair, lack of luster (LL), thinness and sparseness (Thn) and dyspigmentation (dysp); moon-face; for the eyes, pale conjunctiva (PC) and corneal xerosis (CX); for lips, angular stomatitis (AS); for the tongue, abnormally red (Red) and edema (E); for the gums, spongy, bleeding gums (Spng); thyroid gland enlargement (Thyr), for the skin, pellagrous dermatosis (PD), follicular hyperkeratosis (FH) and xerosis (X); edema; hepatomegaly.

** References are as follows: *Aguaruna* (Berlin and Markell, 1977); *Kayapó* (Ayres and Salzano, 1972); *Piaroas* (n=217), *Guahibos* (n=188), *Cuibas* (n=34), and *Piapocos* (n=13) (Bosa and Baumgartner, 1962); San Carlos area (Holmes, 1981); *Tukánoans* (Ortiz, 1981); *Waorani* (Larrick et al., 1979); *Witotos* (Gomez, 1968).

Clinical signs

The number of cases of what investigators have called "malnutrition" is very low: 3 cases in 184 *Kayapó* (Ayres and Salzano, 1972); <5% of 293 *Waorani* (Larrick et al., 1979); 1 case in 112 *Aguaruna* (Berlin and Markell, 1977); 0 cases in 222 *Siona-Secoya* (Bénéfice et al.,1989). More common in the literature are descriptions of the excellent health of Amerindians, but these are typically with reference to adults, and usually males.

Clinical signs of undernutrition related to the condition of the hair (sparseness, pluckability, discoloration) have been reported for *Aguaruna*, *Tukánoan* and San Carlos children (Table III). The presence of these signs is consistent with anthropometric indicators of undernutrition in these groups. There is little evidence of specific nutrient deficiencies. The only goiter reported was for the *Xavánte*, although iodine deficiency without goiter has been reported for the *Yanomámi* (Riviere et al., 1968). It is of considerable interest that goiter has not been reported for any of the groups on cassava-based diets since cassava is known to be goitrogenic (Delange et al., 1982).

There is no evidence of vitamin A deficiency among Amerindians, although this is a major health problem in many areas of the tropics. There are a number of good sources of carotenes in the diet, most notably peach palm (*Bactris gasipaes*).

SUMMARY AND CONCLUSIONS

In summary, the diets of Native Amazonians in tropical forest environments are based on cassava and plantains/bananas, with high quality protein coming from wild fauna.

Wild plant foods do not appear to be very important in the diets of most groups, but their role has not been well studied and may be underestimated. The composition of Amerindian diets is known for only a few groups. It appears adequate in energy and protein, but the diets are high in bulk and low in caloric density. Dietary intake of household groups and adults appears adequate, and the nutritional status of adults is generally good. Children, however, are small for their age, and in some groups many would be classified as undernourished in the basis of weight-for-height, height-for-age, and/or clinical signs of undernutrition. It is likely that diet in combination with disease stress is responsible for the delayed growth and relatively poor nutritional status seen in some children.

This paper reviews and evaluates the available data on diet and nutritional status of Amerindians living in the tropical forests of Amazonia. The diets of most Amerindians are based on cassava and plantains/bananas, with high quality protein coming from fish, game and invertebrates. The composition of Amerindian diets is known for only a few groups. In these groups the dietary intake of households and adults appears to be adequate in energy and protein. However, the high bulk, low caloric density of the diets suggests that they are not concentrated enough for children. Anthropometric data is available for a number of groups. Adults are small in size, but nutritional status assessed in terms of weight-for-height is generally good. Children are small for their age, and in some groups more than 10% would be classified as undernourished on the basis of weight-for-height, and/or clinical signs.

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